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Draft Technical Memo

To:	WRIA 35 Planning Committee		
From:	Jory Oppenheimer and John Koreny	Project:	WRIA 35 Level II – Water Quality
CC:	Ben Floyd, HDR/EES		
Date:	March 10, 2005	Job No:	22592

RE: TUCANNON TEMPERATURE CONDITIONS

This memorandum addresses compliance with temperature standards in the Tucannon River based on our review of recent data, summarizes previous temperature modeling conducted in the Tucannon River, and lists potential next steps.

The main topics addressed in this memorandum include:

- Temperature standards for the Tucannon River
- Basis for 303(d) listing of Tucannon River for temperature
- Existing Tucannon River temperature data compared with temperature standards
- Previous temperature modeling of the Tucannon River
- Potential next steps

PROJECT STUDY AREA

The watershed study area is shown on Figure 1. Land use in the Tucannon River watershed is 37% cropland, 35% rangeland, and 27% forest (EPA 1999). The lower section of the river is characterized by high summertime stream temperatures. Factors contributing to elevated temperatures include irrigation diversions and lack of riparian vegetation. Channelization, widening, and straightening of the stream channel occurred between 1937 and 1978; most of the channelization occurred after the major floods of 1964-65. Small shallow lakes and ponds draining into the Tucannon River may also contribute to temperature increases (EPA 1999).

TEMPERATURE STANDARDS FOR TUCANNON CREEK

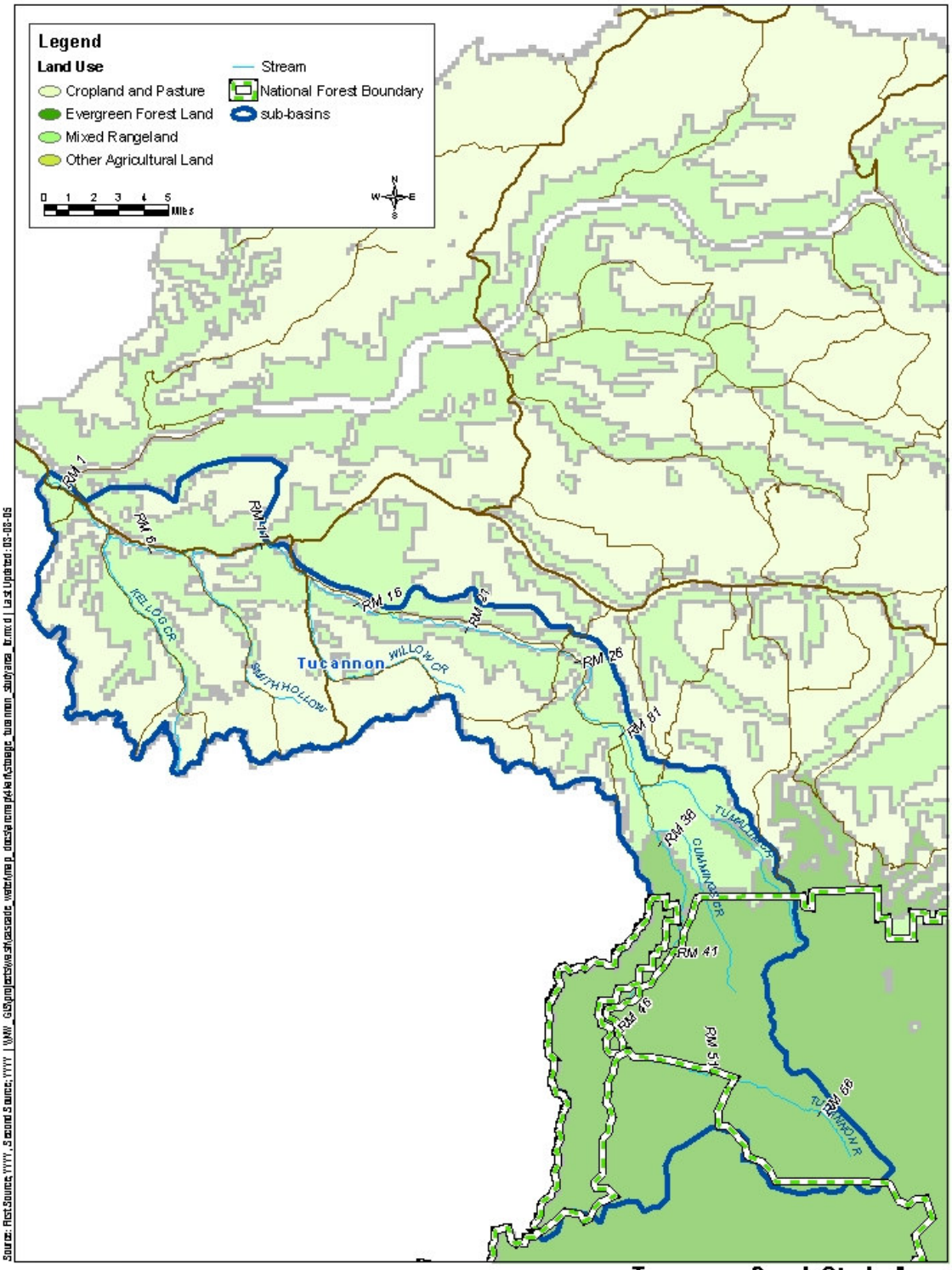
The current and proposed temperature standards for Tucannon Creek are summarized in Table 1.

Current (1997) Temperature Standards

The Water Quality Standards for Washington (WAC 173-201A) designate Tucannon River as Class A (excellent) waters from the mouth to the Umatilla National Forest (river mile 38.1). Above river mile 38.1, the Tucannon River is classified as a Class AA (extraordinary) waterbody.

Proposed (2003) Temperature Standards

The proposed water quality standards designate the Tucannon River as Core/Salmon waters from the mouth to the Umatilla National Forest with a temperature criterion of 16 °C. The river is designated as Char within the Umatilla National Forest, with a temperature criterion of 12 °C.



Tucannon Creek Study Area

Figure 1

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HDR Engineering, Inc.

500 108th Avenue Northeast, Suite 1200
Bellevue, Washington 98004-5549

www.hdrinc.com

Telephone (425) 453-1523
(425) 450-6200
Fax (425) 453-7107

Table 1
Existing and Proposed Temperature Standards for the Tucannon River

	Current (1997)		Proposed (2003)	
Location	**Classification**	**Criteria**	**Classification**	**Criteria [1]**
Mouth to RM 38.1	Class A	Temperature shall not exceed 18.0 °C [2]	Core/Salmon (to Punjab Creek)	16 °C
Above RM 38.1	Class AA	Temperature shall not exceed 16.0 °C [3]	Char	12 °C

1. Highest 7-DADMax. When a water body's temperature is warmer than the criteria in Table 1 (or within 0.3°C (0.54°F) of the criteria) and that condition is due to natural conditions, then human actions considered cumulatively may not cause the 7-DADMax temperature of that water body to increase more than 0.3°C (0.54°F).
2. Due to human activities. When natural conditions exceed 18.0 °C, no temperature increases will be allowed which will raise the receiving water temperature by greater than 0.3 °C.
3. Due to human activities. When natural conditions exceed 16.0 °C, no temperature increases will be allowed which will raise the receiving water temperature by greater than 0.3 °C.

BASIS FOR 303(d) LISTING

The basis for the 303(d) listing of Tucannon River is summarized in Table 2. The 1998 303(d) is the latest list approved by EPA. Ecology will likely submit the 2002/2004 303(d) list to EPA for approval in April 2005 (Ken Koch, Ecology, personal communication, 2005).

Table 2
Rationale for 303d Listing for Tucannon River

303(d) List	Stream segment ID #	Basis for listing
1998	KL66VJ	10 excursions beyond the criterion out of 38 samples (26%) at Ecology ambient monitoring station 35B060 (RM 2.3) between 9/91 and 9/96.
2002/2004	13855	7-day mean of daily maximum values of 23.4 for the week ending 16 August 2001at the station called ' Tucannon River - King Grade RD'.
2002/2004	13859	7-day mean of daily maximum values of 22.4 for the week ending 13 August 2001 at the station called ' Tucannon River - Bridge 12'
2002/2004	13984	7-day mean of daily maximum values of 18.4 for the week ending 9 July 2001 at the station called ' Tucannon River - Camp Wooten Bridge'.
2002/2004	13850	7-day mean of daily maximum values of 25.3 for the week ending 16 August 2001 at the station called ' Tucannon River - HWY 12 Bridge'.
2002/2004	13853	7-day mean of daily maximum values of 24 for the week ending 3 August 2000 at the station called ' Tucannon River - Enrich RD'
2002/2004	13864	7-day mean of daily maximum values of 20.6 for the week ending 17 July 2002 at the station called ' Tucannon River - Cummings Creek Br'
2002/2004	13849	7-day mean of daily maximum values of 25.5 for the week ending 17 July 2002 at the station called ' Tucannon River - Smith Hollow RD'
2002/2004	13982	7-day mean of daily maximum values of 20.2 for the week ending 17 July 2002 at the station called ' Tucannon River - FS Info Sign'
2002/2004	13983	7-day mean of daily maximum values of 19.1 for the week ending 18 July 2002 at the station called ' Tucannon River - Big 4 Lake'

Table 2
Rationale for 303d Listing for Tucannon River (cont.)

303(d) List	Stream segment ID #	Basis for listing
2002/2004	13856	7-day mean of daily maximum values of 22.9 for the week ending 4 August 2000 at the station called ' Tucannon River - Marengo Bridge'2 excursions beyond the criterion out of 12 samples collected between 1993 - 2001 measured on these dates: 97/07/06, 97/08/03
2002/2004	13857	7-day mean of daily maximum values of 22.6 for the week ending 12 August 2001 at the station called ' Tucannon River - Bridge 10'
2002/2004	13848	7-day mean of daily maximum values of 25.9 for the week ending 14 July 2001 at the station called ' Tucannon River - Smolt Trap (HW261)'
2002/2004	13861	7-day mean of daily maximum values of 21.7 for the week ending 16 August 2001 at the station called ' Tucannon River - Bridge 14'
2002/2004	3725	7-day mean of daily maximum values of 26 for mid-week 13 August 2001; 11 excursions beyond the criterion out of 40 samples collected between 1993 - 2001

Source: Ecology's 303(d) list web page.

Refer to Figure 1 for locations of these stations.

COMPARISON OF MEASURED DATA WITH TEMPERATURE STANDARDS

Figures 3 and 4 compare the temperatures measured in the Tucannon River in 2004 with the current (1997) and proposed (2003) temperature criteria. These graphs show that temperatures in the Tucannon River exceeded the criteria between June and September.

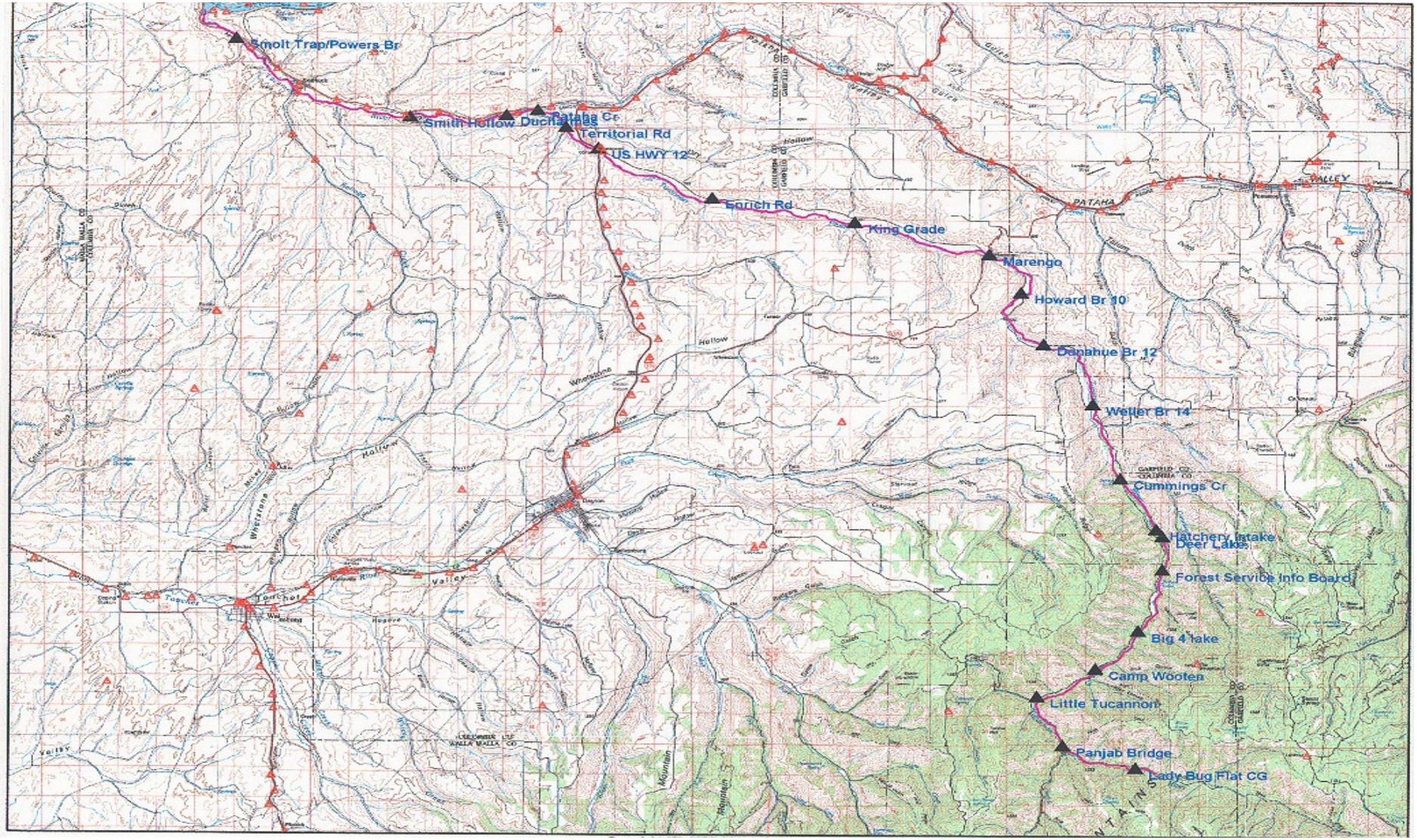


Figure 2 Tucannon temperature monitoring stations

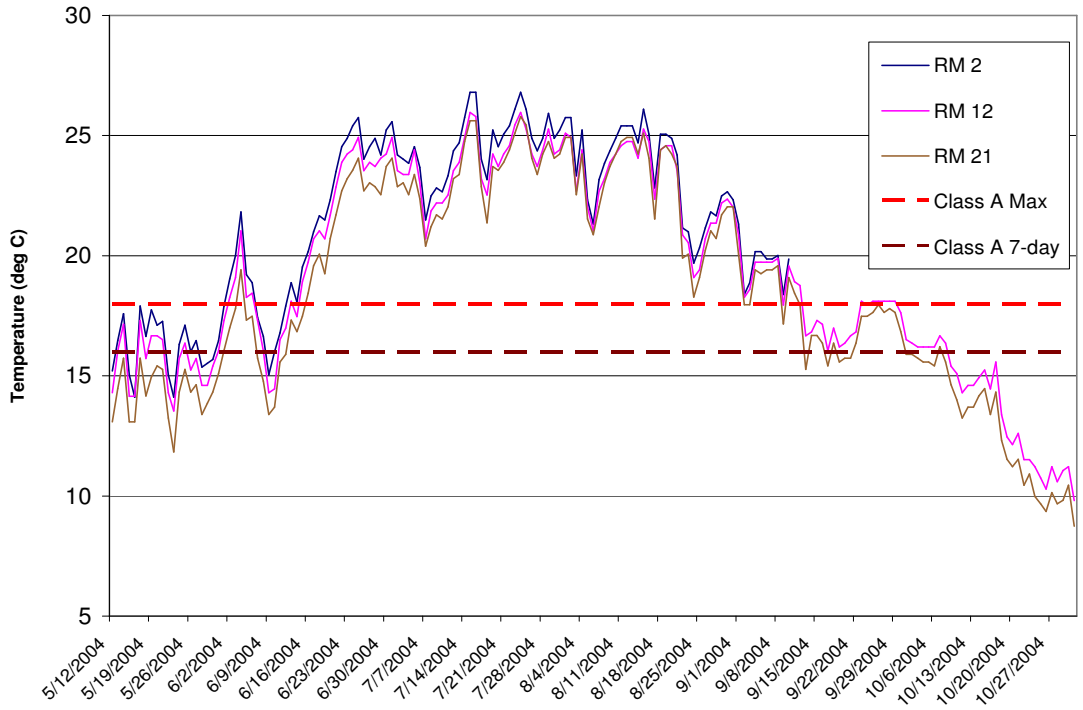


Figure 3. Tucannon maximum daily temperatures in 2004 at stations located between the mouth and RM 38.1.

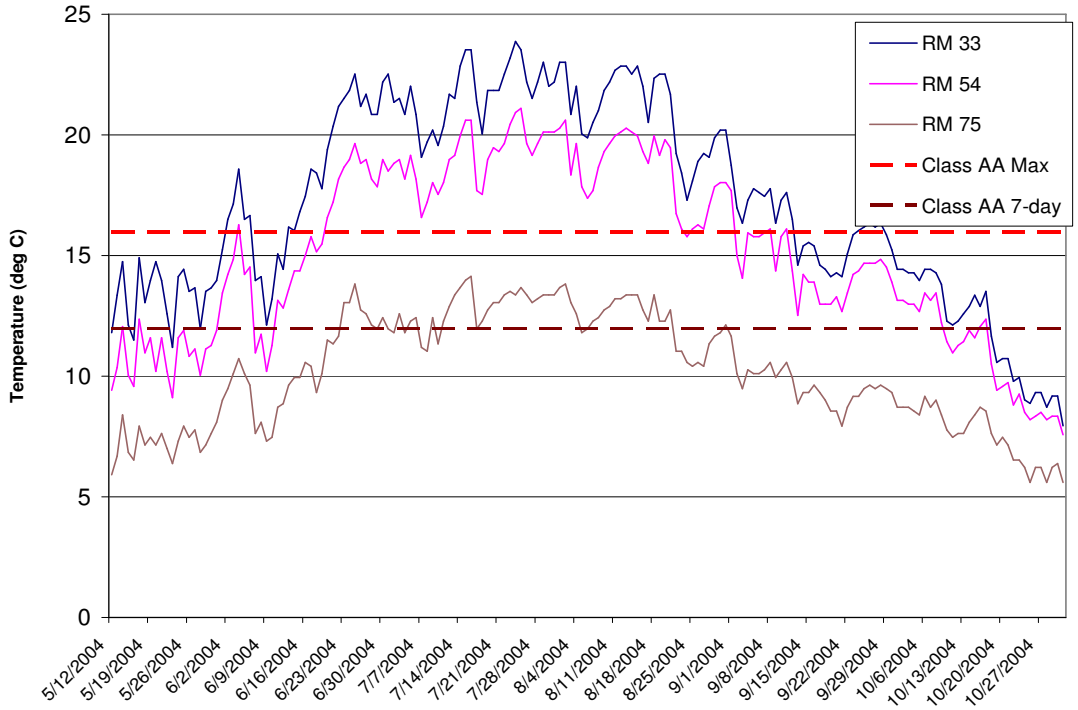


Figure 4. Tucannon maximum daily temperatures in 2004 in the stations located between RM 38.1 and the headwaters

In addition to specific numeric criteria, the standards reference "natural conditions" temperature based on what temperatures would be without changes caused by humans. According to - the policy Ecology uses to place waterbodies on the 303(d) list (Ecology's Water Quality Program Policy 1-11),

> "Under the water quality standards, a measurement of temperature (or other pollutant) in excess of a standard is not a violation of the standard if the exceedance results from natural conditions. In the case of temperature and dissolved oxygen, when natural conditions exceed the standard, an allowance for human contribution is provided; a human contribution less than this allowance is not considered a violation, but a human contribution in excess of it is." (Ecology 2002).

Computer modeling is a method available to estimate temperatures under natural background conditions. The section below summarizes previous temperature modeling conducted for the Tucannon River which predicted temperature conditions under natural conditions and different riparian shade conditions.

PREVIOUS TEMPERATURE MODELING OF THE TUCANNON RIVER (THUEUR ET AL., 1985)

A comprehensive temperature modeling study was conducted for the Tucannon River in the mid-1980s. The results of the temperature modeling are documented in Theurer et al. (1985). The model included a shade module that was used to predict the effects of stream temperatures caused by topography and riparian vegetation. The main purpose of this modeling was to evaluate the potential for improvement in fish habitat from riparian and channel restoration. As summarized by an EPA report (EPA 1999):

> "The potential for recovery in water temperature regime in stream reaches and longitudinally in a stream system is well illustrated on the Tucannon River subbasin, Washington, by Theurer et al. (1985). They used the stream segment temperature model SSTEMP developed by the Soil Conservation Service and the US Fish and Wildlife Service to predict stream temperature profiles along the Tucannon's entire mainstem length under historic climax vegetation and channel morphology condition. This modeling exercise required extensive data on current and historic riparian cover and channel widths. It was estimated that by restoring riparian cover and channel morphology to predevelopment conditions, the mean daily water temperature for July observed at the mouth (22.4°C) could be reduced to 19.1°C. Current mean maximum water temperature for July measured at the mouth of the Tucannon River was 26°C (Theurer et al. 1985), but would be reduced to 22°C if all riparian and channel morphology restoration is done. This amount of temperature recovery does not account for limitations that may still be caused by loss of pool volume due to in-channel sedimentation, restoration of wetlands, reduction of road density, or riparian restoration on tributaries (see Rhodes et al. 1994)." (EPA 1999).

The temperature modeling was used to analyze four riparian vegetation and channel morphology conditions for 1980 and 1981:

- **Existing Conditions** – the riparian and channel conditions as of 1980.
- **Climax Conditions** – what the riparian vegetation and channel morphology would be if floods and subsequent stream channelization in the mid-1960s had not destroyed the riparian vegetation boundary. (The climax riparian vegetation was estimated by studying the existing vegetation in relict riparian zones along the river). The loss of riparian vegetation caused bank instability in the lower end of the river, which resulted in considerable straightening.

- **Alternative 1** – assumes restoration of the riparian vegetation (stream shade) down to Pataha Creek confluence (RK 19). No stream realignment or adjustments of the cross section.

- **Alternative 2** – assumes restoration of the riparian vegetation to the Snake River. No stream realignment or adjustments of the cross section.

Alternatives 1 and 2 assumed the planting of young shade trees that would reach maximum effectiveness (maximum stream shade) in 20 years. The peak temperature period - May through September - was modeled. A schematic of one of the modeled scenarios is shown in Figure 54 and a graph of modeled temperatures in July is shown in Figure A-1.

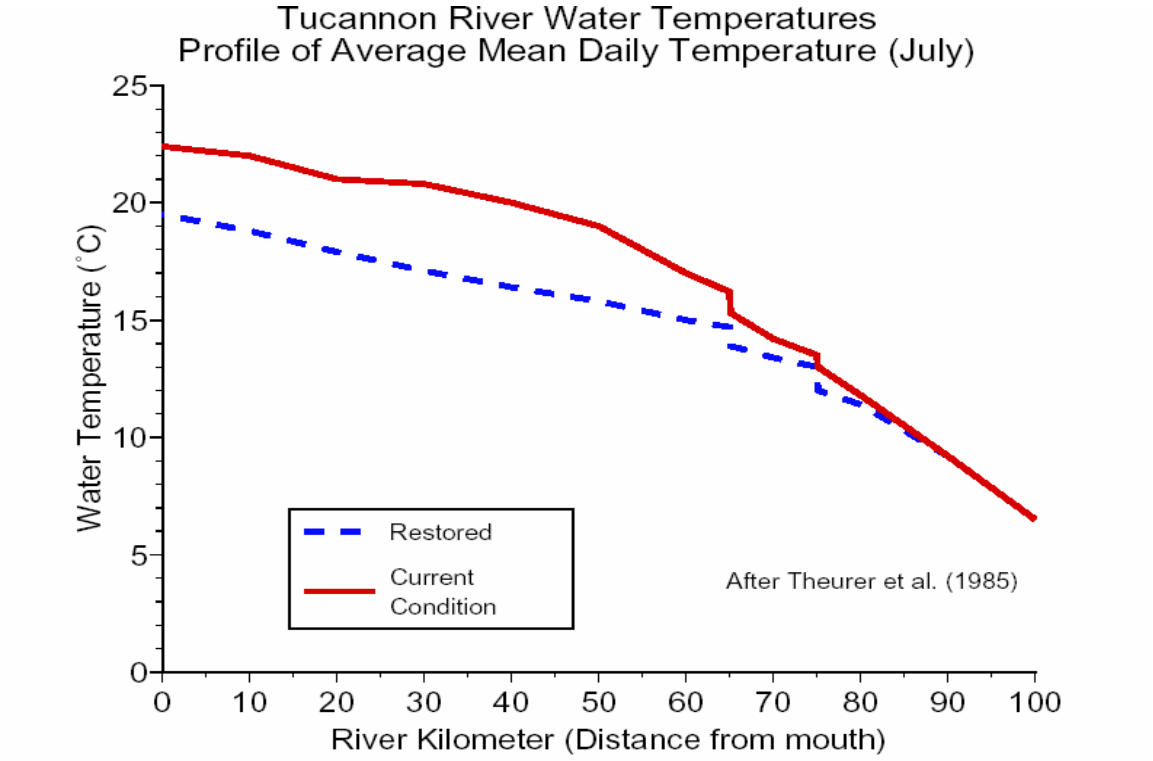


Figure 5. Tucannon River average mean daily water temperatures for July estimated by use of temperature modeling (Theurer et al. 1985) for management alternatives ranging from the current condition to restored mainstem conditions (restoration of riparian vegetation and channel morphology) (As reported in EPA 1999).

The results indicated temperature improvements in the Tucannon River below about RK 65 as a result of riparian vegetation improvements.

POTENTIAL NEXT STEPS

We suggest that a potential next step is to update the temperature modeling for the Tucannon River. This suggestion is based on our review of existing temperature data, requirements for temperature standards, the previous temperature modeling and the potential uses of a temperature model.

The potential uses of a temperature model for the Tucannon could be to:

- **Demonstrate Riparian Shading** – The model could be used to demonstrate (quantify) the benefits of riparian shading projects and to set a target for riparian vegetation improvements. Riparian projects could be prioritized by modeling portions of the river with different levels of riparian shading.
- **Predict Benefits or Impacts of Projects**– The model could be used to evaluate the temperature impacts to the Tucannon River as a result of proposed of off-site storage or changes to instream flow or stream channel restoration.
- **Establish Natural Conditions Temperatures**– Establishing natural temperature conditions of the Tucannon River could be important for 303(d) listing, potential TMDL studies, and determining a baseline target for riparian improvement projects.

  Temperatures in the Tucannon River currently exceed the existing and proposed numeric criteria. Because temperature standards reference natural conditions, it is unlikely that the Tucannon River would be removed from the 303(d) unless it is demonstrated that the temperatures are the result of natural conditions. The modeling could be used to establish natural conditions temperatures and these results could then be submitted to Ecology for 303(d) listing.

  Additionally, Ecology will be conducting scoping for TMDLs in WRIA 35 this fall. Because temperatures seem to be the main water quality concern, Ecology may propose a temperature TMDL for the Tucannon River. Ecology typically uses effective shade for its allocation in temperature TMDLs, which is the approach similar to the proposed modeling effort.

Modeling Approach

The approach would be to develop a model using information about recent riparian conditions and data for meteorological conditions, flow, and temperature.

- Use the extensive physical data of channel characteristics from the previous (SNTEMP) model for the Tucannon River documented by Theurer et. al. 1985.
- Calibrate the model to flows/temperature/meteorological data during July or August of this year (2005). For Ecology to accept modeling, the analysis would need to approximate temperature conditions during critical conditions (7Q10 flows). Low flows, near 7Q10 or lower, may occur this year.
- Verify the model to one other year under different flow/temperature conditions.
- Develop a “natural conditions” scenario based on riparian shade estimates.

REFERENCES

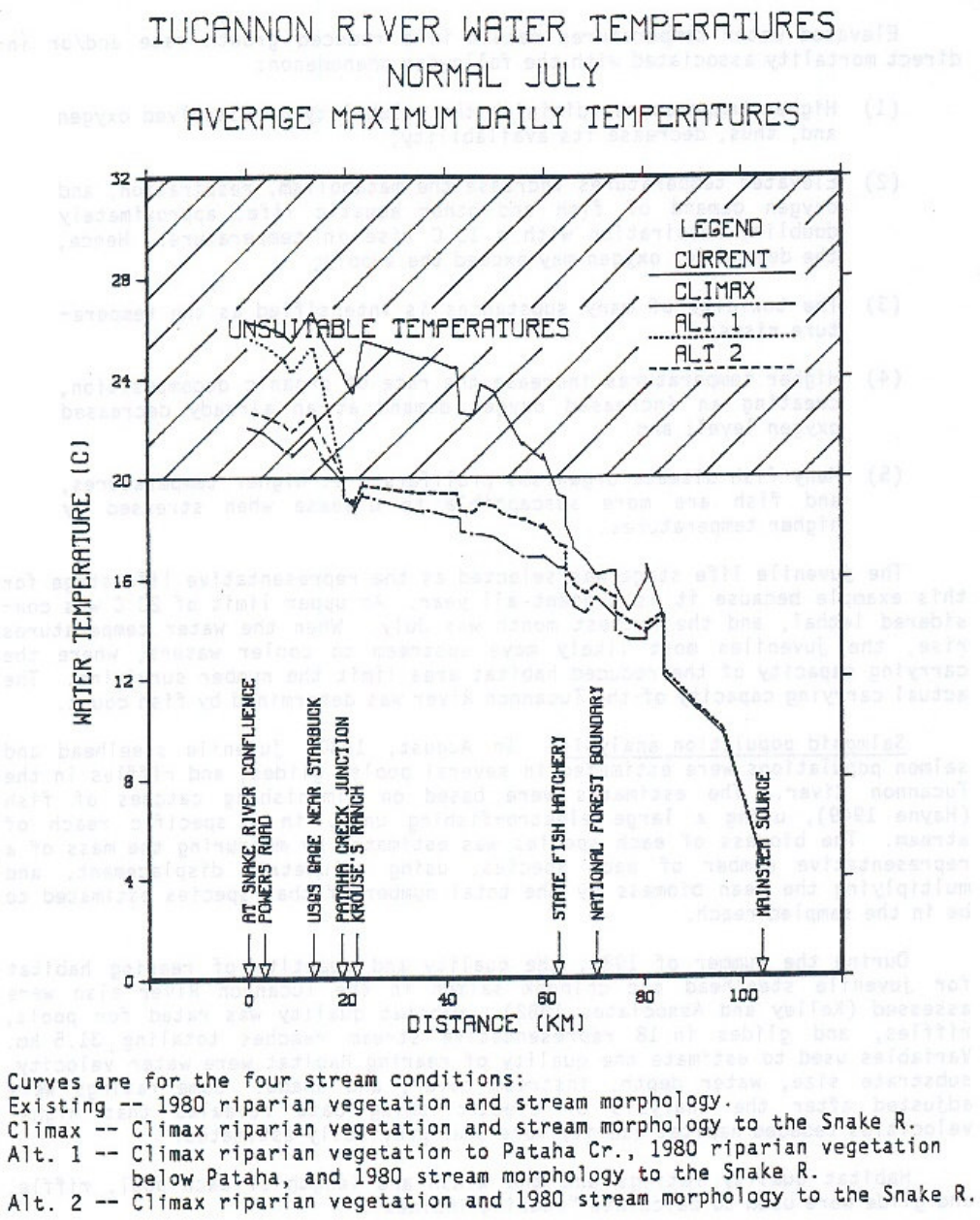
Ecology 2002/2004 web page: http://www.ecy.wa.gov/programs/wq/303d/index.html

Ecology 2002. Water Quality Program Policy 1-11. September 2002.

Theurer F.D., I. Lines, and T. Nelson. 1985. Interaction Between Riparian Vegetation, Water Temperature, and Salmonid Habitat in the Tucannon River Water Resources Bulletin. Vol 21. No. 1.

Theurer, F.D., Voos, K.A., and W.J. Miller. 1984. In-stream Water Temperature Model. Instream Flow Inf. Paper 16. FWS/OBS-84/15. In-stream Flow and Aquatic System Group, U.S. Fish and Wildlife Service. Fort Collins, CO.

U.S. EPA. 1999. A review and synthesis of effects of alterations to the water temperature regime on freshwater life states of salmonids, with special reference to chinook salmon. EPA 910-R-99-010, July 1999. 279pp.



Attachment A-1: Modeled longitudinal temperature profile of the Tucannon River for four modeled scenarios (reprinted from Theurer et. al., 1985).